632. SCIENCE STANDARDS - MIDDLE GRADES, (GRADES 7-8) SECTIONS 633 THROUGH 643.

Based on the necessary math knowledge and skills, student maturation level, and the need for secondary level Physical Science exposure, it is recommended that Earth Science be scheduled at the middle school level. The standards reflect this recommendation.

The samples associated with the content standards are meant to illustrate meaning and to represent possible areas of applications. They are not intended to be an exhaustive list, but are samples of applications that would demonstrate learning.

633. UNIFYING CONCEPTS OF SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand systems, order, and organization.	a. Define and order small systems of a whole for the purpose of investigation.	i. Illustrate how different organisms interact with one another to create an ecosystem. ii. Illustrate the make up and interactions of the solar system using models. iii. Illustrate how compound machines are composed of many simple machines.
	b. Know the different structural levels of which an organism is comprised: cells, tissues, organs, organ systems, and organisms.	i. Create a model that shows how one structural level builds to the next by using triangles or bubbles as individual cells.
	c. Know that there is order and predictability in the universe.	i. Predict animal behaviors. ii. Predict weather patterns. iii. Predict how Newton's laws affect an object in space.
	d. Know that patterns and similarities allow us to organize information about our universe.	i. Use taxonomic key to classify organisms. ii. Identify the major grouping of elements on the periodic table. iii. Classify minerals by chemical composition.
02. Understand concepts and processes of evidence, models, and explanation.	a. Use observations and data as evidence on which to base scientific explanations and predictions.	i. Create a data table or graph showing the diversity of plants in a given area. ii. Create a comparison graph showing the average temperature of two regions. iii. Create a graph showing how the temperature of ice changes when adding salt.
	b. Use observations to make defendable inferences.	i. Use discrepant events to make observations and inferences to explain them. ii. Do "mystery box" activity (making observations and inferences).
	c. Develop and/or use models to explain or demonstrate a concept.	i. Build a model of an atom.
	d. Develop scientific explanations based on scientific knowledge, logic, and analysis.	i. Hypothesize why raisins in a glass of pop rise and fall.

03. Understand constancy, change, and measurement.	a. Identify concepts in science that do not change with time.	i. Demonstrate the law of conservation of mass and energy. (Apply to energy pyramid.) ii. Demonstrate radioactive decay using marble activity. iii. Speed of light.
	b. Analyze changes that occur in and among systems.	i. Compare the elevation of Mt. Borah before and after the 1983 earthquake. ii. Using model cars compare the speed at different points along a ramp.
	c. Measure precisely in metric units using appropriate tools.	i. Measure length, volume, mass (balance), weight (scale), and temperature.
04. Understand the theory that evolution is a process that relates to the gradual changes in the universe and of equilibrium as a physical state.	a. Understand the relationships of past, present, and future.	i. Compare fossils to living organisms. ii. Use rocks of today to document past changes in the earth.
	b. Understand that evolution refers to the biological, geological, or astronomical change over time.	i. Explain the changes that occurred in the peppered-moth. ii. Explain how a black hole develops. iii. Explain how land in the Pacific Northwest has changed over time.
	c. Understand that equilibrium is a physical state of balance in which changes and forces occur in opposite and offsetting directions.	i. Give an example of homeostasis. ii. Do an experiment demonstrating diffusion or osmosis. iii. Demonstrate how balanced forces affect motion or the size of a star.

634. CONCEPTS OF SCIENTIFIC INQUIRY.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand scientific inquiry and develop critical thinking skills.	a. Develop complex questions that can be answered by conducting long-term studies.	i. Generate a question about a local water issue. • macro invertebrates • coliform contamination • pH, temperature, nitrate, phosphates, turbidity, dissolved oxygen
	b. Design and conduct scientific investigations using controls and variables when appropriate.	i. Hypothesize an answer to the stated question. ii. Design and conduct experiment to answer the question about your local water issue.
	c. Select and use appropriate tools and techniques to gather and display data.	i. Use data probes, pH paper, dissolved O_2 test kits, to obtain information. ii. Construct tables and graphs to display data.

	d. Analyze data in order to form conclusions.	i. Compare data obtained with national water quality standards. ii. Draw conclusions from individual or class data.
	e. Think critically and logically to accept or reject a hypothesis.	i. Explain why a hypothesis was accepted or rejected.
	f. Analyze alternative explanations and predictions.	i. Write a letter to the Department of Environmental Quality explaining results. ii. Formulate alternative hypotheses generated from collected data.
	g. Communicate and defend scientific procedures and explanations.	i. Write a letter to the Department of Environmental Quality defending the results. ii. Orally defend scientific results to classmates.
	h. Recognize the differences among observations, hypotheses, mathematical laws, and theories.	i. Research historical development of a law. • Newton's three laws • Law of gravity • Plate tectonics

635. CONCEPTS OF PHYSICAL SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the structure and function of matter and molecules and their interactions.	a. Understand that all matter is made up of atoms, which may be combined in various kinds, ways, and numbers.	i. Create a model of an atom.
	b. Use properties to identify matter.	i. Identify a mystery substance by describing its properties and calculating its density.
	c. Identify physical properties and know the nature of a physical change.	i. Demonstrate a phase change of a substance (ice to water).
02. Understand chemical reactions.	a. Demonstrate that chemical reactions may release or consume energy.	i. Demonstrate a chemical reaction that uses or releases heat.
03. Understand concepts of motion and forces.	a. Know how an object's position, direction of motion, and speed can be measured.	i. Describe and measure the distance and time a toy car travels and calculate its speed.
	b. Compare and contrast the relationships among different forms of energy.	

04. Understand that the total energy in the universe is constant.	a. Explain how energy can be transformed from one form to another but is neither destroyed nor created.	i. Observe Newton's Cradle (swinging balance balls) and explain how this shows that energy is neither created nor destroyed. ii. Compare and contrast potential and kinetic energy (pendulum).
	b. Understand that energy is transferred from one place to another.	i. Demonstrate how heat moves from a warmer object to a colder one until they both reach the same temperature.

636. CELLULAR AND MOLECULAR CONCEPTS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the cell is the basis of form and function for all living things and how living things carry out their life functions.	a. Know the relationships among specialized cells, tissues, organs, organ systems, and organisms.	i. Given a cancer cell, predict how it will affect tissues, organs, organ systems, and the organism.
	b. Know the parts of plant and animal cells and the functions of the various cell structures.	i. Create a model of animal and plant cells showing organelles and describe the functions of each organelle. ii. Given a mystery slide or picture, distinguish whether it is a plant or animal cell.
	c. Know that most cell functions involve chemical reactions.	i. Diagram cell respiration.
	d. Know that genes and chromosomes carry the information for traits.	i. Use pipe cleaners to represent chromosomes and show how a gene on the chromosome carries a trait.
	e. Know that traits are inherited, including dominant and recessive traits.	i. Using Wisconsin fast plants, cross-pollinate plants and observe the rules of heredity.
	f. Know that genetic information is replicated and passed on to new cells.	i. Use models to demonstrate mitosis and meiosis.
	g. Know that transmission of chromosomal information to offspring occurs through asexual or sexual reproduction.	i. Grow or diagram how plants can reproduce sexually and asexually.

637. INTERDEPENDENCE OF ORGANISMS AND BIOLOGICAL CHANGE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the theory of biological evolution.	a. Know that species change over time when random variations in individuals enhance their survival and reproductive success in a particular environment.	i. Do a simulation of the English Peppered-moth activity. ii. Compare beaks of finches of the Galapagos Islands.

	b. Know that species may become extinct when the environment changes and their adaptive characteristics are insufficient to allow their survival.	i. Research the extinction of a species.
	c. Know that biological classifications are based on similarities, which reflect their evolutionary relationships.	i. Classify an organism using a dichotomous key. ii. Compare two closely related species (coyote and wolf).

638. MATTER, ENERGY, AND ORGANIZATION IN LIVING SYSTEMS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the relationship between matter, energy, and organization to trace matter as it cycles and energy as it flows through living systems and between living systems and the environment.	a. Know that the energy stored in food is primarily derived from the sun through photosynthesis.	
	b. Know that the distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy.	i. Complete and discuss the "Project Wild" How Many Bears Are in the Forest?
	c. Know that atoms and molecules cycle among the living and nonliving components of the biosphere.	i. Diagram photosynthesis and respiration (oxygen cycle). ii. Diagram the carbon cycle and nitrogen cycle.
	d. Trace energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.	i. Explain a food chain or the food pyramid, showing what happens to energy that came originally from the sun.
02. Understand the individual behavior of organisms and their interactions in populations and communities as influenced by physiological and environmental factors.	a. Know that organisms have behavioral responses to internal and external stimuli.	
	b. Know that living organisms have the capacity to produce populations of infinite size but that environments and resources are finite.	i. Start with a large bag of M&Ms. One student representing the first generation removes M&Ms with a spoon into a cup. One student representing the second generation removes M&Ms with a spoon into a cup. Allow each successive generation five seconds to fill cups until M&Ms are depleted. Discuss and relate to other finite resources.

639. EARTH AND SPACE SYSTEMS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand scientific theories of origin and subsequent changes in the universe and earth systems.	a. Know that there are interactions among the solid earth, oceans, atmosphere, and organisms, which result in a change of the earth's system. (Some interactions are observable such as earthquakes and volcanic eruptions, but many take place over hundreds of millions of years.)	i. Explain the formation of the Hawaiian Islands.
	b. Compare earth with other planets with emphasis on conditions necessary for life.	i. Compare data from Mars with what is known about Earth regarding water, air, temperature, etc.
	c. Understand the motions that explain such occurrences as the day, the seasons, the year, phases of the moon, eclipses, and tides.	i. Create a model showing the earth, sun, and moon relationships.
	d. Know that the development of life caused dramatic changes in the composition of the earth's atmosphere.	i. Describe how the earth's atmosphere would be different if life had never developed. ii. Describe how the balance of gases in our atmosphere is maintained by living things.
	e. Know that the universe is constantly expanding.	i. Explain the Doppler Shift.
	f. Know that stars and galaxies have a life cycle.	i. Explain the evolution of a star.
	g. Know methods used to estimate geologic time (observing rock sequences, using fossils to correlate the sequences at various locations).	i. Create a sedimentary fossil record using layers of gelatin.
02. Understand geo-chemical cycles and energy in the earth system.	a. Know that earth systems have internal and external sources of energy.	i. Explain geothermal energy. ii. Explain why the poles are colder than the equator.
	b. Know that the earth's internal heat causes the plates of the earth's surface to move.	i. Explain the formation of the Hawaiian Islands.
	c. Know that the heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents affecting global climate.	i. Describe how solar heating of the earth drives the water cycle. ii. Describe why the oceans along the Pacific and Atlantic coasts are such different temperatures.

640. TECHNOLOGY.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the relationship between science and technology and develop the abilities of technological design and application.	a. Know that science and technology are human endeavors interrelated to each other, to society, and to the work place.	i. Explain how science has aided in the development of a technological device and how that device has aided in the advancement of science (electron microscope, computer).
	b. Compare and contrast scientific inquiry and technological design in terms of activities, results, and influence on individuals and society: know that science enables technology and vice versa.	i. Discuss inventions that resulted from the space program. ii. Participate in an "Invention Convention."
	c. Create a tool to perform a specific function.	
	d. Use available and appropriate technology.	
	e. Know the elements of technological design, which include the following: - Identify a problem; - Propose a solution; - Implement a proposed solution; - Evaluate the solution and its consequences; - Communicate the problem, process, and solution.	i. Construct a device or product that will improve some aspect of human life or solve a problem (better mousetrap, faster toy car, stronger tool).

641. PERSONAL AND SOCIAL PERSPECTIVES.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand common environmental quality issues, both natural and human induced.	a. Identify environmental issues and conduct studies.	i. Compile a case study of a local environmental issue and describe its impact on Idaho's economy.
02. Understand the causes and effects of population change.	a. Understand the effect of technological development and the growth of human population on the living and nonliving components of the environment.	i. Take a field trip to the local sewage treatment center or water treatment plant. ii. Clean up the schoolyard, a park, or a waterway.
03. Understand the importance of natural resources and the need to manage and conserve them.	a. Explore alternative sources of energy.	i. Collect trash and divide into renewable and nonrenewable resources. ii. Visit a managed forest or mine.

	b. Understand the role and effect of management of natural resources.	i. Discuss the use of fire in a forest management program.

642. HISTORY OF SCIENCE.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand the significance of major scientific milestones.	a. Understand the impact of historical scientific events.	i. Create a timeline showing scientific events.

643. INTERDISCIPLINARY CONCEPTS.

Standard - The student will:	Content Knowledge and Skills:	Samples of Applications:
01. Understand that interpersonal relationships are important in scientific endeavors.	a. Work in teams to solve problems.	i. Conduct an experiment or activity while working on a team.
02. Understand technical communication.	a. Read, understand, and follow technical instructions.	i. Build a model using the technical instructions. ii. Follow lab procedure directions.
	b. Write and articulate technical information.	i. Write instructions for a lab procedure to be followed by another student.
	c. Write a long-term investigation.	